

3.2 HANFORD SITE

Hanford, established in 1943 as one of the three original Manhattan Project sites, is located in the State of Washington just north of Richland (see Figures 2.2.1–1 and 2.2.1–2). Hanford was a U.S. Government nuclear materials production site that included nuclear reactor operation, storage and reprocessing of spent nuclear fuel, and management of radioactive and dangerous wastes. Present Hanford programs are diversified and include management of radioactive wastes, R&D for advanced reactors, renewable energy technologies, waste disposal technologies and cleanup of contamination, and Pu stabilization and storage.

Hanford is owned and used primarily by DOE, but small portions of it are owned, leased, or administered by other government agencies. Public access is limited to travel on the Route 4 and Route 10 access roads as far as the Wye Barricade, Highways 24 and 240, and the Columbia River. By restricting access onsite, the public is buffered from the smaller areas formerly used for production of nuclear materials and currently used for waste storage and disposal. Only about 6 percent of the land area has been disturbed and is actively used, leaving mostly open vacant land with widely scattered facilities. The entire Hanford Site has been designated a National Environmental Research Park (NERP).

Hanford includes extensive production, service, research, and development areas. Onsite programmatic and general-purpose facilities total approximately 799,337 m² (8,600,000 ft²) of space. Fifty-one percent (407,658 m² [4,390,000 ft²]) is general-purpose space, including offices, support laboratories, shops, warehouses, and other support facilities. The remaining 391,679 m² (4,216,000 ft²) of space are programmatic facilities comprising processing, evaporation, filtration, waste recovery, waste treatment, waste storage facilities, and R&D laboratories. More than half of the general-purpose and programmatic facilities are more than 30 years old. Facilities designed to perform previous missions are being evaluated for reuse in the cleanup mission (HF DOE 1993c:2). The existing facilities are grouped into the following numbered operational areas (see Figure 2.2.1–2):

- The 100 Areas, located on the southern shore of the Columbia River, are the site of eight retired Pu production reactors and the dual-purpose N Reactor, all of which have been permanently shut down since 1991. The 100 Areas cover about 1,100 ha (2,720 acres).
- The 200 West and 200 East Areas are located on a plateau and are about 8 and 11 km (5 and 7 mi), respectively, south of the Columbia River. Historically, these areas have been dedicated to fuel reprocessing; Pu processing, fabrication, and storage; and waste management and disposal activities. The 200 Areas cover about 1,600 ha (3,950 acres).
- The 300 Area, located just north of the city of Richland, is the site of nuclear and nonnuclear research and development to include the Pacific Northwest Laboratory (PNL). This area covers 150 ha (370 acres).
- The 400 Area, approximately 8 km (5 mi) northwest of the 300 Area, is the location of the recently shut down FFTF and FMEF. FFTF is an advanced liquid metal-cooled research reactor that was used in the testing of breeder reactor systems. FMEF consists of several connected buildings. The six-level Process Building (427 Building) is the main structure of the FMEF and encloses approximately 17,000 m² (183,000 ft²) of operating area. This building has never been operated and is free of contamination. The exterior walls are reinforced concrete, and the cell walls are constructed of high-density concrete. The facility was designed and constructed for spent fuel examination and was subsequently partially converted for MOX fuel fabrication.
- The 600 Area comprises the remainder of Hanford, which includes most of the undisturbed land and has the following key attributes:

- Fitzner-Eberhardt Arid Lands Ecology Reserve (ALE), set aside for ecological studies
 - Living sand dunes
 - Cultural/historical facilities and sites
 - Hanford Reach free-flowing Columbia River
 - Old growth sagebrush/habitat areas
 - A patrol training facility
 - A low-level radioactive waste disposal site, which is leased by the State of Washington and subleased to a commercial enterprise (U.S. Ecology)
 - Washington Public Power Supply System (WPPSS) nuclear power plants
 - Waste Sampling and Characterization Facility
 - Support facilities and infrastructure (for example, roads, railroads, telecommunications, water treatment and distribution, electrical transmission lines/substations, fire/ambulance, and access control facilities, borrow pits, and a landfill)
 - DOE waste disposal sites
 - A 260-ha (640-acre) parcel of land transferred to the State of Washington as a potential site for a hazardous waste disposal facility
 - Meteorological towers and facilities
 - A wildlife refuge under revocable use permit to the USFWS
 - A recreational game management area under revocable use permit to the State of Washington Department of Fish and Wildlife
 - A gravitational-wave observatory, presently under construction
- The 700 Area is the administrative center in downtown Richland and consists of government-owned buildings (for example, the Federal Building).
 - The 1100 and 3000 Areas are support areas located in north Richland. The 1100 Area includes support services such as general stores and transportation maintenance. The 3000 Area is being vacated but still contains some administrative and support facilities.

In addition, there are DOE-leased facilities and DOE contractor privately owned facilities, which support Hanford operations, located on private land south of the 300 Area and outside of the 1100 and 3000 Areas (HF PNL 1994b:5).

Department of Energy Activities. The Hanford mission is to clean up the site, provide scientific and technological excellence to meet global needs, and to partner the economic diversification of the region (HF DOE 1994a:3-6). The current DOE activities that support Hanford's mission are shown in Table 3.2-1. In

the area of waste management, Hanford has embarked on a long-range cleanup program in compliance with the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) and applicable Federal, State, and local laws. DOE has set a goal of cleaning up Hanford's waste sites and bringing its facilities into compliance with Federal, State, and local environmental laws by the year 2028 (HF PNL 1994b:3). In addition, as part of the cleanup mission, DOE has the responsibility to safely store, handle, and stabilize Pu materials and spent fuel.

Table 3.2-1. Current Missions at Hanford Site

Mission	Description	Sponsor
Waste management	Store defense wastes and handle, store, and dispose of radioactive, hazardous, mixed, or sanitary wastes from current operations	Assistant Secretary for Environmental Management
Environmental restoration	Restore approximately 1,100 inactive radioactive, hazardous, and mixed waste sites and about 100 surplus facilities	Assistant Secretary for Environmental Management
Research and development	Conduct research in the fields of energy, health, safety, environmental sciences, molecular sciences, environmental restoration and waste management research and development, and national security activities	Various DOE Program Managers
Technology development	Develop new technologies for environmental restoration and waste management, including site characterization and assessment methods, and waste minimization	Various DOE Program Managers
Economic transition	Use the cleanup and science and technology mission elements to help the community establish a diversified and stable economic base over the long term	Assistant Secretary for Environmental Management

Source: HF DOE 1994a; HF PNL 1994b.

Non-Department of Energy Activities. In addition to the DOE mission-related activities listed in Table 3.2-1, Hanford has some unique and diverse assets and non-DOE missions, such as the following:

- The Fitzner-Eberhardt ALE Reserve, 31,100 ha (76,800 acres), established in 1967, is managed by Battelle Pacific Northwest Laboratory for DOE with assistance from the Nature Conservancy as a habitat and wildlife reserve and nature research center
- The area north of the Columbia River that is managed in part by the Washington State Department of Wildlife as the Wahluke Slope Wildlife Recreation Area and in part by USFWS as Saddle Mountain National Wildlife Refuge
- The Washington Nuclear Plant-2 (WNP-2) 1,100 MWe reactor operated by WPPSS and also the partially completed WNP-1 reactor
- The Laser Interferometer Gravitational-Wave Observatory, operated by the National Science Foundation as one of two widely separated installations (within the United States) that are operated in unison as a single gravitational-wave observatory
- Hanford Meteorological Station and towers
- An observatory and radio telescope facilities located on Rattlesnake Mountain
- The U.S. Ecology commercial low-level radioactive waste disposal site on State-leased lands near the center of Hanford

3.2.1 LAND RESOURCES

Land Use. The discussion of land resources at Hanford includes land use at Hanford and surrounding area. Hanford encompasses approximately 145,000 ha (358,000 acres) of mostly vacant land in the south-central area of the State of Washington. The land area is relatively flat and dominated by grasses and sagebrush. The Columbia River, which flows through the site, is the area's most important geographical feature. [Text deleted.]

Existing Land Use. Existing generalized land uses at Hanford and its vicinity are shown in Figure 3.2.1-1. All land within Hanford is owned by the Federal Government and is administered and controlled by DOE. Land use in the area southeast of Hanford includes residential, commercial, and industrial development in the Tri-Cities area. This area, encompassing the cities of Richland, Kennewick, and Pasco, is the closest population center and has about 107,000 residents. Agriculture is a major land use in the remaining area surrounding Hanford.

Hanford contains a variety of widely dispersed facilities, including old reactors, R&D facilities, the WPPSS nuclear power facility, consisting of the incomplete WNP-1 reactor and the complete WNP-2 reactor, and various production and processing plants within the specialized operational areas described in Section 3.2. As shown in Figure 3.2.1-1, sensitive open space areas include the Fitzner-Eberhardt ALE Reserve, approximately 31,100 ha (76,800 acres) near Rattlesnake Mountain; and two areas north of the Columbia River: the Saddle Mountain National Wildlife Refuge (12,220 ha [30,200 acres]), which is administered by USFWS, and the Wahluke Unit Columbia Basin Wildlife Area (22,260 ha [55,000 acres]), which is managed by the Washington State Department of Fish and Wildlife (HF NPS 1994a:314,315).

Public access to ALE Reserve and Saddle Mountain National Wildlife Refuge is prohibited (HF DOE 1992b:24,34). Other special status lands within the vicinity include McNary National Wildlife Refuge, administered by USFWS, and Columbia River Islands Area of Critical Environmental Concern (ACEC) and McCoy Canyon, both administered by BLM (Figure 2.2.1-2). McNary National Wildlife Refuge and Columbia River Islands ACEC consist of several islands within the Columbia River that are closed to public access for approximately 6 months of the year (HF NPS 1994a:315,316). The U.S. Department of Agriculture, National Resources Conservation Service does not identify prime farmland on Hanford. However, some soil mapping units have the potential to be prime farmland soils if irrigated (WA USDA 1996a:1).

In 1975, DOE designated the entire Hanford Site area as a NERP, an outdoor laboratory for ecological research to study the environmental effects of energy developments. The Hanford NERP is a sagebrush-steppe habitat that contains a wide range of arid land ecosystems and offers the opportunity to examine linkages between terrestrial, subsurface, and aquatic environments on a systems basis (DOE 1985a:1,3). The closest residence is approximately 30 m (98 ft) from the north Hanford boundary. There is also a mobile home park approximately 60 m (197 ft) from the south boundary.

Land-Use Planning. The DOE Richland Operations Office (RL) has undertaken comprehensive land-use planning to define how best to utilize land at Hanford for the next 30 to 40 years. The December 1994 Secretary of Energy Policy requires RL to manage its land and facilities as valuable national resources. The resulting Comprehensive Land-Use Plan (CLUP) will identify existing and planned future land uses with accompanying restrictions, cover a specific timeframe, and be updated as needed. The development and evaluation of the CLUP will be integrated with the upcoming *Hanford Remedial Action Environmental Impact Statement*. Together, these processes will identify land-use cleanup scenarios, create a remediation baseline for the environmental restoration program, and provide a framework for the future management and utilization of land at Hanford.

Private lands bordering Hanford are subject to the planning regulations of Benton, Franklin, and Grant Counties, and the city of Richland. The majority of Hanford, particularly the site area not reserved as a buffer, is situated within Benton County. Benton County and the city of Richland currently have a comprehensive land-use planning process under way, with statutory mandated deadlines under the State of Washington *Growth*

Management Act (GMA) of 1990. The GMA requires Benton County and the city of Richland to include portions of Hanford in their plans.

The county and city planning could be carried out independently, without any integration with DOE. This would have a significant potential for overlap and duplication, which would result in public confusion as to how the plans relate to each other. To avoid this, RL's integrated CLUP/HRA-EIS process includes coordinating internal organizational and external involvement activities. Tribal Nations, local cities, counties, and State and Federal agencies are voluntarily and cooperatively participating in the preparation of the CLUP to eliminate duplication of efforts and attempt to identify and resolve conflicts early on. A single integrated Geographical Information System data management system is being used to ensure optimum consistency and compatibility among the end products each government agency is developing. The CLUP is scheduled to be implemented by RL in April 1997, after the ROD from the HRA EIS is issued.

Visual Resources. Hanford is located in the Pasco Basin of the Columbia Plateau north of the city of Richland, which is at the confluence of the Yakima and Columbia Rivers. Site topography ranges from generally flat to gently rolling. In the north-central part of the site, two small east-west ridges, Gable Butte and Gable Mountain, rise approximately 60 m (197 ft) and 180 m (591 ft), respectively, above the surrounding terrain. Rattlesnake Hills, Rattlesnake Mountain, Umtanum Ridge, and Yakima Ridge are located along the southwestern and western site boundaries, and the Saddle Mountains are located along the northern site boundary. The Columbia River flows through the northern part of the site and, turning south, forms part of the eastern site boundary. A 79.7-km (49.5-mi) segment of the Columbia River extending downstream from below Priest Rapids Dam to near Johnson Island (river mile 346.5 to 396) is currently protected and is part of a Proposed Action designating this segment of the Hanford Reach as a Wild and Scenic River (HF NPS 1994a:5,62,311). The Yakima River runs along a small portion of the southern site boundary (Figure 3.2.1-1).

The site is dominated by widely spaced low brush and grasslands, typical of the regional shrub-steppe desert. A large area of unvegetated mobile sand dunes is located along the eastern site boundary, and unvegetated blowouts are scattered throughout the site. Hanford consists mostly of undeveloped land, with widely spaced clusters of industrial buildings located along the southern and western banks of the Columbia River and at several interior locations. The WPPSS nuclear power facility is also located along the west bank of the Columbia River. The adjacent visual landscape consists mainly of rural rangeland and farms; the city of Richland, part of the Tri-Cities area, is the only adjoining urban area. Construction and operation of the DOE and WPPSS facilities have disturbed the character of the landscape within their respective areas. The DOE and WPPSS facilities are brightly lit at night and highly visible from many areas. The plume of steam that rises high into the air at the WPPSS facility is also highly visible from the surrounding area, including portions of the Tri-Cities area. The developed areas of Hanford are consistent with a VRM Class 5 designation. The remainder of the site ranges from a VRM Class 3 to Class 4 designation.

Viewpoints affected by DOE and WPPSS facilities are primarily associated with the public access roadways (including State Highways 24 and 240, Hanford Road, Horn Rapids Road, and Route 4 South/Stevens Drive), the bluffs along the east bank of the Columbia River, and the north edge of the city of Richland. Views of DOE facilities from the surface of the Columbia River are generally blocked by high river banks; however, stack plumes from the WPPSS facility are visible. Because of the semi-arid climate, views can exceed 80 km (50 mi); however, topographic relief provides significant visual screening of the Hanford facilities.

The most sensitive visual areas include the Columbia River, because of its potential designation as a Wild and Scenic River, and the northern part of the city of Richland that borders the site, because of the high-density commercial and residential land use. Route 4 South/Stevens Drive is the only affected public access roadway with high traffic volumes. However, since this route primarily serves the DOE and WPPSS facilities, user sensitivity is low. Although some facilities are visible from the east bank of the Columbia River, densities are low and, in most instances, the viewing distances are great.

3.2.2 SITE INFRASTRUCTURE

Baseline Characteristics. Activities at Hanford are concentrated at facilities in several general areas previously described in Section 3.2. To support these missions, an extensive infrastructure exists. Baseline site infrastructure characteristics are shown in Table 3.2.2-1.

Table 3.2.2-1. Hanford Site Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	420	420
Railroads (km)	204	204
Electrical		
Energy consumption (MWh/yr)	345,500	1,678,700
Peak load (MWe)	58	281
Fuel		
Natural gas (m ³ /yr)	459,200	20,804,000
Oil and propane (l/yr)	9,334,800	14,775,000
Coal (t/yr)	41,580	91,708
Steam (kg/hr)	40,847	40,847

Source: HF DOE 1990e.

The site infrastructure provides for transportation of personnel and most material shipments by road. Bulk materials (primarily coal), large equipment, irradiated fuel, and radioactive solid and liquid wastes are transported by rail. High-level and low-level liquid radioactive wastes from past process operations are transported between waste management facilities by encased pipeline. Large barged shipments (decommissioned submarine reactor cores) are routinely offloaded at the Port of Benton dock facility (on the Columbia River in north Richland) and transported to a site disposal facility using special multiwheeled trailers.

Hanford has a network of paved roads. Only 104 km of the 420 km (65 of 261 mi) of these roads are accessible to the public. Hanford is also crossed by State Route 240, which is the main route traveled by the public. Most onsite employee travel is on Route 4, the primary highway from the Tri-Cities to most Hanford outer area work locations. A recently constructed access road between State Route 240 and the 200 West Area has alleviated peak traffic congestion on Route 4. Access to the outer areas (100 and 200 Areas) is controlled by DOE at the Yakima, Wye, and the new Rattlesnake barricades.

Onsite rail transport is provided by a short-line railroad owned by DOE, which controls all access. Hanford's railroad is a Class III Railroad System, as defined by the Federal Railroad Administration. Its common carrier tie is with the Union Pacific Railroad in Richland. A series of maintenance upgrades to the site's main trackage was completed in 1994. The Hanford railroad will continue to support site cleanup in a variety of ways, such as transporting liquid waste, contaminated soils, construction materials, spent nuclear fuel, large equipment, and closure materials.

Electricity, the only regional utility service supplied to Hanford, is provided by the Bonneville Power Administration (BPA). A site electrical transmission and distribution system is used to provide power to the majority of Hanford. The city of Richland distributes power for about 3 percent of the total site usage. Hanford is a Priority Firm customer, and the BPA is contractually obligated to provide as much power as the site requires. Being a Priority Firm customer ensures that, in the event of severe regional power shortages, Hanford (along with other Priority Firm customers) would be the last level of BPA service to be shut off. Power to the BPA grid is dominated by hydropower (more than 70 percent), which provides a typically reliable source of power.

Hydropower is normally more constrained by seasonal variation in peak demand than in meeting momentary peak demand levels. The Northwest Sub-Regional Power Pool capabilities are shown in Table 3.2.2-2.

Natural gas, provided by the Cascade Natural Gas Corporation, is currently used in a few locations on Hanford. Fuel oil and propane are also used in some areas. Coal is currently used to fuel the 200 East Area central steam plant, which also supplies steam to the 200 West Area. The steam system (production and distribution) in the 200 Areas was built in the 1940s, and upgrade and replacement are required to maintain reliability. Natural gas, in conjunction with distributed package boilers, is planned for alternative steam production and heating systems. These improvements are planned for 1996.

Table 3.2.2-2. Northwest Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel^a	
Coal	34%
Nuclear	3%
Hydro/geothermal	46%
Oil/gas	7%
Other ^b	11%
Total Annual Production	256,404,000 MWh
Total Annual Load	250,045,000 MWh
Energy Exported Annually	6,359,000 MWh
Generating Capacity	49,596 MWe
Peak Demand	33,325 MWe
Capacity Margin^c	13,655 MWe

^a Percentages do not total 100 percent due to rounding.

^b Includes power from both utility and nonutility sources.

^c Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

The Columbia River is the primary source of raw water for Hanford. The average annual river flow through the site is approximately 203 million l/minute (min) (50 million gal/min). The Export Water System, with a capacity of 124,900 l/min (33,000 gal/min), serves the 200 Areas and most of the shutdown 100 (reactor) Areas. The 100 K East and K West Areas have an independent river source. Wells supply water to the 400 Area and a variety of low-use facilities at remote locations. The administrative and research areas in north Richland are supplied with water by the city of Richland.

Most of the weapons-usable Pu at Hanford is stored in the PFP. The PFP is a group of buildings located in an enhanced security portion of 200 West Area around the 234-5Z Building. The total area (all levels) is approximately 25,000 m² (270,000 ft²), including processing and all service/support space.

The PFP complex includes the following: Pu processing systems in gloveboxes and cells, HVAC systems (some with multiple stages of HEPA filtration), analytical laboratory, developmental laboratory, maintenance shops, administrative offices; security features, and fire suppression systems. Additional services, such as fire protection, medical services, security support, steam, water, and electrical power, are provided to the PFP from site services. [Text deleted.]

The original purpose of the PFP was to convert Pu nitrate into metal ingots and weapons components. The facility is essentially self-sustaining; its process capability is supported by scrap recycle capability, Pu storage, and maintenance/repair facilities. The 234-5Z Building has no identified future missions beyond Pu stabilization

and is programmed for D&D. The newer 2736-Z Pu storage vault and two ancillary structures are located immediately south of the 234-SZ Building and provide 8,224 storage spaces for Pu. This facility will continue to be utilized for Pu storage until new facilities are constructed or the Pu is shipped offsite. Approximately 25 percent of 2736-Z has been dedicated as a vault where Pu material can be stored under IAEA surveillance.

The ROD resulting from the *Plutonium Finishing Plant Stabilization Final Environmental Impact Statement* (DOE/EIS-0244-F) decided to remove Pu material in holdup in the PFP and stabilize the holdup and other Pu-bearing material at the PFP. Following stabilization, Pu will be in a form suitable for interim storage in existing vaults at the PFP Facility. Low Pu content material could be treated to meet WIPP Waste Acceptance Criteria.

Another existing facility complex at Hanford that could be used to store or process Pu is the FMEF. The FMEF consists of several connected buildings located in the 400 Area. The six-level Process Building (427 Building), the main structure of the facility, has an attached single-level mechanical wing on the west side and an emergency power wing at the northwest corner. The Process Building encloses approximately 17,650 m² (190,000 ft²) of operating area and extends from 30 m (100 ft) above grade to about 11 m (36 ft) below grade. This building has never been operated and is free of contamination. The exterior walls are made of reinforced concrete 0.3 m (1.0 ft) thick and the cell walls are constructed of high-density concrete 1.2 m (4.0 ft) thick. Some of the walls within the facility are used as both load-bearing and radiation-shielding walls. In some locations, high-density concrete is used for cell-shielding walls because of specific shielding requirements. The other building within the FMEF complex is a two-level building (4682 Building), which is connected to the south side of the Process Building. The 4682 Building is divided into two portions: (1) the administrative portion known as the entry wing and (2) the shop portion, which was designed to house the Fuel Assembly Area for fabrication of MOX fuel and test assemblies for the FFTF.

3.2.3 AIR QUALITY AND NOISE

Meteorology and Climatology. The climate at Hanford and in the surrounding region is characteristically that of a semiarid steppe. The humidity is low, and winters are mild. The average annual temperature is 11.8 °C (53.3 °F); average monthly temperatures range from a minimum of -1.5 °C (29.3 °F) in January to a maximum of 24.7 °C (76.5 °F) in July. The average annual precipitation is 16.0 cm (6.3 in). The prevailing winds at Hanford are from the northwest. The average annual windspeed is 3.4 m/second (s) (7.6 miles per hour [mph]) (HF PNL 1994b:83-84). Additional information related to meteorology and climatology at Hanford is presented in Appendix F.

Ambient Air Quality. Most of Hanford is located within the South-Central Washington Intrastate Control AQCR (#230) with a small portion of the site being located in the Eastern Washington-Northern Idaho Interstate AQCR (#62). None of the areas within Hanford and its surrounding counties are designated as a nonattainment area (40 CFR 81.348) with respect to NAAQS for criteria pollutants (40 CFR 50). Applicable NAAQS and Washington Ambient Air Quality Standards are presented in Appendix F.

Four PSD (40 CFR 52.21) Class I areas have been designated in the vicinity of Hanford: Goat Rocks Wilderness Area, located 145 km (90 mi) west of the site; Mount Rainier National Park, located 160 km (99 mi) west of the site; Mount Adams Wilderness Area, located 153 km (95 mi) southwest of the site; and Alpine Lakes Wilderness Area, located 177 km (110 mi) northwest of the site.

Since the creation of the PSD program in 1977, permits were obtained for nitrogen dioxide (NO₂) emissions from Pu-uranium extraction and uranium oxide plants located in the 200 Area. The maximum increases in the annual NO₂ concentration at the Hanford boundary were estimated to be negligible (Table 3.2.3-1).

Ambient air quality within and near the Hanford boundary is currently monitored for NO₂ and particulate matter. The ambient air quality data collected during the last few years are either very small percentages of the limits set in applicable ambient standards (sulfur dioxide [SO₂] and carbon monoxide [CO]) or substantially lower than the limits set in applicable ambient standards.

At Hanford, the major sources of criteria air pollutants (pollutants for which a NAAQS has been written including PM₁₀, SO₂, NO₂, CO, ozone [O₃], and lead [Pb]) are coal-burning boilers and fugitive coal piles. Other emissions include other process emissions, vehicular emissions, and temporary emissions from various construction activities. Most of the process emissions at Hanford will have been discontinued, and space heating requirements will be met by burning natural gas by 2005 as reflected in the No Action emissions presented in Appendix F.

Table 3.2.3-1 presents the baseline ambient air concentrations for criteria pollutants and other pollutants of concern at Hanford. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. The major noise sources within Hanford include various facilities, equipment, and machines (for example, cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials handling equipment, and vehicles). Data from two noise surveys indicate that background noise levels (measured as 24-hour equivalent sound level) at Hanford range from 30 to 60.5 dBA (Appendix F). The 24-hour background sound level at undeveloped areas at Hanford ranges from 24 to 36 dBA, except when high winds elevate sound levels (HF PNL 1994a:4.145). The primary source of noise at the site and nearby residences is traffic. Most Hanford industrial facilities are at a sufficient distance from the site boundary that noise levels at the boundary from these sources are not measurable or are barely distinguishable from background noise levels.

The State of Washington has established noise standards for different source and receptor areas. Hanford belongs to source area Class C (industrial). The maximum allowable noise level for residential, commercial, and

Table 3.2.3-1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Hanford Site, 1994

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ^a ($\mu\text{g}/\text{m}^3$)	Baseline Concentration ($\mu\text{g}/\text{m}^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000 ^b	0.7
	1-hour	40,000 ^b	2.6
Lead	Calendar Quarter	1.5 ^b	<0.01
	24-hour	0.5 ^c	<0.01
Nitrogen dioxide	Annual	100 ^b	0.2
Ozone	1-hour	235 ^b	^d
Particulate matter less than or equal to 10 microns in diameter	Annual	50 ^b	0.01
	24-hour	150 ^b	0.1
Sulfur dioxide	Annual	52 ^c	0.8
	24-hour	260 ^c	6.6
	3-hour	1,300 ^b	22.9
	1-hour	1,018 ^c	47.9
	1-hour	655 ^{c,e}	47.9
Mandated by the State of Washington			
Gaseous fluoride	30-day	0.8 ^c	^f
	7-day	1.7 ^c	^f
	24-hour	2.9 ^c	^f
	12-hour	3.7 ^c	^f
Total suspended particulates	Annual	60 ^c	0.01
	24-hour	150 ^c	0.1
Hazardous and Other Toxic Compounds			
Arsenic	Annual	0.00023 ^{c,g}	0.00019
Cadmium	Annual	0.00056 ^{c,g}	0.00008
Chromium	24-hour	1.7 ^{c,g}	0.0029
Copper	24-hour	3.3 ^{c,g}	0.0018
Formaldehyde	Annual	0.077 ^{c,g}	0.00017
Manganese	24-hour	0.4 ^{c,g}	0.0040
Nickel	Annual	0.0021 ^{c,g}	0.00097
Polycyclic organic matter	24-hour	^h	0.19
Selenium	24-hour	0.67 ^{c,g}	0.00036
Vanadium	24-hour	0.17 ^{c,g}	0.010

^a The more stringent of the Federal and State standards is presented if both exist for the averaging time.

^b Federal and State standard.

^c State standard.

^d Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

^e The standard is not to be exceeded more than twice in any seven consecutive days.

^f No sources of the pollutant have been identified.

^g Risk-based acceptable source impact levels.

^h No State standard for indicated averaging time.

Source: 40 CFR 50; HF 1995a:1; WA Ecology 1994a.

industrial receptor areas is 50 to 70 dBA (Appendix F). Hanford is currently in compliance with State and Federal noise regulations.

3.2.4 WATER RESOURCES

Surface Water. Major surface water features at Hanford are the Columbia River (northern and eastern sections), the Yakima River, springs along the Columbia River and on Rattlesnake Mountain, and onsite ponds (Figure 3.2.4-1).

The flow of the Columbia River is regulated by 11 dams within the United States, 7 upstream and 4 downstream of the site (HF PNL 1994a:4.40). Located approximately 10 km (6.2 mi) upstream of Hanford, the Priest Rapids Dam is the nearest dam, while McNary is the nearest dam downstream (80 km [50 mi]). The portion of the Columbia River between these dams is referred to as the Hanford Reach. Flows through the Hanford Reach fluctuate significantly and are controlled primarily by operations at Priest Rapids Dam. The annual average flow rate in the vicinity of Priest Rapids Dam is approximately 3,360 cubic meters (m^3/s) (118,642 cubic feet [ft^3/s]) (HF PNL 1994a:4.40).

The Yakima River, bordering a short length of the southern portion of Hanford, has a low annual flow rate compared to the Columbia River (HF PNL 1994a:4.42). The average annual flow rate is about 104 m^3/s (3,673 ft^3/s). Approximately one-third of Hanford is drained by the Yakima River System.

Rattlesnake Springs and Snively Springs, located on the western part of Hanford, form small surface streams. Rattlesnake Springs flows for about 3 km (1.9 mi) before disappearing into the ground (Figure 3.2.4-1). Cold Creek and its tributary, Dry Creek, are ephemeral streams located in the southern portion of Hanford (HF PNL 1994a:4.42). These streams drain areas to the west of Hanford and cross the southwestern part of the site toward the Yakima River. Surface flow, when it occurs, infiltrates rapidly and disappears into the surface sediments in the western part of the site.

The primary uses of the Columbia River include the production of hydroelectric power, transportation, and extensive irrigation in the Mid-Columbia Basin (HF PNL 1994a:4.40). Another principle use of the river is by the fishery industry. Several communities located along the Columbia River rely on the river as their source of drinking water and for recreational purposes. Water from the Columbia River along the Hanford Reach is also used as a source of drinking water by several onsite facilities and for industrial uses.

Large Columbia River floods have occurred in the past, but the likelihood of recurrence of large-scale flooding has been reduced by the construction of several flood-control and water-storage dams upstream of the site (HF PNL 1994a:4.42). Major floods on the Columbia River are typically the result of rapid melting of the winter snowpack over a wide area augmented by above-normal precipitation. The largest flood on record occurred June 7, 1894, with a peak discharge at Hanford of 21,000 m^3/s (741,615 ft^3/s). The floodplain associated with the 1894 flood was limited to within approximately 3 km (1.9 mi) of the banks of the river. The largest recent flood took place in 1948, with an observed peak discharge of 20,000 m^3/s (706,300 ft^3/s) at Hanford. The probability of flooding at the magnitude of the 1894 and 1948 floods has been greatly reduced because of upstream regulation by dams (HF PNL 1994a:4.42).

Major flooding of the Yakima River, which has occurred several times this century, could extend into a small portion of the southern section of Hanford, but the upstream Yakima River is physically separated from Hanford by Rattlesnake Mountain, which would prevent major flooding on Hanford (HF PNL 1994a:4.43). There are no Federal Emergency Management Agency (FEMA) floodplain maps for the Hanford Reach of the Columbia River. FEMA only maps developing areas, and the Hanford Reach is specifically excluded.

Surface Water Quality. The State of Washington has classified the stretch of the Columbia River from Grand Coulee to the Washington-Oregon border, which includes the Hanford Reach, as Class A, excellent raw drinking water, recreation area, and wildlife habitat. The Columbia River is currently in compliance with applicable State and Federal drinking water standards (HF PNL 1994a:4.58).

Water samples have been collected periodically from the Hanford Reach of the Columbia River. Radionuclides consistently detected in the river during 1993 were iodine-129 (I-129), strontium-90 (Sr-90), tritium, U-234, and uranium-238 (U-238). In addition, technetium-99 (Tc-99), U-238, and Pu-239/240 were detected in 50 percent or more of the samples analyzed during the year. Total alpha and beta measurements were similar to previous years and were approximately 5 percent or less of the applicable drinking water standards of 15 and 50 picocuries (pCi)/l (4 pCi/gal and 13.2 pCi/gal), respectively. These measurements are useful indicators of the general radiological quality of the river and, because results are obtained quickly, provide an early indication of changes in radioactive contamination levels. Tritium measurements at Richland were all well below State and Federal drinking water standards. All nonradiological water quality standards were met for Class A-designated water (HF PNL 1994a:4.58). Surface water quality data downstream of Hanford are presented in Table 3.2.4–1.

Surface Water Rights and Permits. The Department has asserted, and continues to assert, a federally reserved water withdrawal right to obtain water from the Columbia River. Currently, Hanford withdraws approximately 13.5 billion l/yr (3.57 billion gal/yr) of water from the Columbia River.

Groundwater. Groundwater under Hanford occurs in unconfined and confined aquifers. The unconfined aquifer lies within the boundaries of the Pasco Basin contained within glaciofluvial sands and gravels of the Hanford Formation as well as the fluvial and lacustrine sediments of the Ringold Formation. Across the site, groundwater generally flows easterly through sands and gravels of the middle member of the Ringold Formation of the unconfined aquifer. The base of the aquifer is the Columbia River Basalt or, in some areas, the clay zones of the lower member of the Ringold Formation. The aquifer thickness ranges from 15 to 61 m (49 to 200 ft), where it thins along the flanks of bordering structures. As a result of local water disposal to surface ponds, the water table has risen as much as 27 m (89 ft) in the 200 West Area (HF PNL 1994a:4.54). This has caused groundwater mounding, including radial and northward flow components, in the 200 Areas. Depth to groundwater ranges from approximately 24 to 80 m (79 to 262 ft) across Hanford. Figure 3.2.4–2 shows the water table elevations and the direction of groundwater movement.

The unconfined aquifer is recharged from rainfall and runoff from higher bordering elevations to the west, water infiltrating from small ephemeral streams, river water along influent reaches of the Yakima and Columbia Rivers, and upward leakage from the lower confined aquifers and from artificial recharge (agricultural irrigation and waste disposal operations at Hanford). In the Hanford vicinity, groundwater is discharged primarily along the Columbia River, with lesser amounts going to the Yakima River (HF PNL 1994a:4.52).

The confined aquifers at Hanford consist of sedimentary interbeds and interflow zones that occur between basalt flows in the Columbia River Basalt Group. Main water-bearing portions of the interflow zones occur within a network of interconnecting vesicles and fractures of the flow tops or flow bottoms. The confined aquifers are continuous throughout most of the Pasco Basin except where the aquifers have been eroded or stratigraphically pinched out. The thickness of these aquifers varies from several centimeters to at least 52 m (171 ft). Recharge of the confined aquifer occurs primarily where the basalt formations are at or near ground levels as water infiltrates from precipitation and stream runoff at areas including the Rattlesnake Hills, Yakima Ridge, Umtanum Ridge, and the Saddle Mountains. Groundwater from these confined aquifers is also discharged to the Columbia River (HF PNL 1994a:4.91).

Groundwater Quality. Groundwater quality at Hanford has been affected by liquid waste released to the soil column by past and ongoing site operations. [Text deleted.] Minor quantities of the longest-lived radionuclides have reached the water table via a failed groundwater monitoring well casing and through reverse well injection, a disposal practice that was discontinued at Hanford in 1947. The unconfined aquifer contains both radiological and nonradiological contaminants at concentrations exceeding water quality criteria and standards. Table 3.2.4–2 shows the unconfined groundwater quality at Hanford. Tritium and I-129 have been detected in the confined aquifer. Contamination in the confined aquifer, however, is typically limited to areas where there is exchange with the unconfined aquifer (HF PNL 1994a:4.52).

Table 3.2.4-1. Summary of Columbia River Surface Water Quality Monitoring at Hanford Site (Richland Pumpouse), 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards ^b	Concentration ^a	
			High	Low
Alpha (gross)	pCi/l	15 ^c	1.69	<1.18x10 ⁻³
Barium	mg/l	2 ^c	0.036	0.029
Beta (gross)	pCi/l	50 ^d	2.8	NR
Calcium	mg/l	NA	22.1	17.0
Chloride	mg/l	250 ^e	1.2	1.01
Chromium	mg/l	0.1 ^c	<2.0x10 ⁻²	5.4x10 ⁻³
Copper	mg/l	1.0 ^c	0.0033	<0.002
Fluoride	mg/l	4 ^c , 2 ^e	0.3	0.1
Iodine-129	pCi/l	20 ^f	0.00014	NR
Iron	mg/l	0.3 ^e	0.0673	0.034
Magnesium	mg/l	NA	5.367	4.055
Manganese	mg/l	0.05 ^e	0.0071	<0.0014
Nitrate	mg/l	10 ^c	0.58	0.35
pH	pH units	6.5-8.5 ^e	8.6	8.1
Potassium	mg/l	NA	1.225	0.087
Plutonium-239/240	pCi/l	1.2 ^f	7.82x10 ⁻⁵	<3.25x10 ⁻⁶
Sodium	mg/l	NA	2.83	2.436
Strontium-90	pCi/l	400 ^f	1.37x10 ⁻¹	<2.39x10 ⁻²
Sulfate	mg/l	250 ^e	11.6	8.2
Technetium-99	pCi/l	4,000 ^f	0.25	NR
Tritium	pCi/l	80,000 ^f	162	48.6
Uranium-234	pCi/l	20 ^f	3.56x10 ⁻¹	1.89x10 ⁻¹
Uranium-235	pCi/l	24 ^f	2.20x10 ⁻²	<-5.05x10 ⁻⁴
Uranium-238	pCi/l	24 ^f	3.19x10 ⁻¹	1.44x10 ⁻¹
Zinc	mg/l	5 ^e	<0.02	<0.0026

^a Data are average values from four separate sampling events.

^b For comparison purposes only.

^c National Primary Drinking Water Regulations (40 CFR 141).

^d Proposed National Primary Drinking Water Regulations: Radionuclides (56 FR 33050).

^e National Secondary Drinking Water Regulations (40 CFR 143).

^f DOE Derived Concentration Guides (DCG) for water (DOE Order 5400.5), DCG values are based on a committed effective dose of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of DCG. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored location. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the background environmental level.

Note: mg/l=milligrams per liter; pCi/l=picocuries per liter; NA=not applicable; NR=not reported.

Source: HF PNL 1994a.

Tritium and nitrate plumes have been identified in the unconfined aquifer at Hanford. Because both are ubiquitous in liquid waste streams and are highly mobile in groundwater, they can be used as good indicators of the extent of groundwater contamination at Hanford. The major plume of tritium-contaminated groundwater has continued to move eastward over the years and has seeped into the Columbia River (HF PNL 1992a:157). The generalized locations of the major plumes are shown on Figure 3.2.4-2.

Groundwater Availability, Use, and Rights. Groundwater in the Pasco Basin area is used for domestic, industrial, and agricultural purposes. The principal groundwater users within Hanford are the FFTF, the PNL, and remote

Table 3.2.4-2. Groundwater Quality Monitoring in the Unconfined Aquifer at Hanford Site, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards ^a	Existing Conditions 1993	
			High	Low
1,2-Dichloroethylene	mg/l	0.007 ^b	180	<dL
Carbon tetrachloride	mg/l	0.005 ^b	7	<dL
Cesium-137	pCi/l	120 ^c	2,087 ^d	<dL
Chromium	mg/l	0.1 ^b	19.1	<dL
Cobalt-60	pCi/l	400 ^c	423	<dL
Iodine-129	pCi/l	20 ^c	64.2	<dL
Nitrate	mg/l	10 ^b	870	<dL
Plutonium-239/240	pCi/l	1.2 ^c	125 ^d	<dL
Strontium-90	pCi/l	400 ^c	7,890 ^e	<dL
Technetium-99	pCi/l	4,000 ^c	20,500 ^f	<dL
Tetrachloroethylene	mg/l	0.005 ^b	0.0059	<dL
Trichloroethylene	mg/l	0.005 ^b	0.061	<dL
Tritium	pCi/l	80,000 ^c	3,590,000 ^g	<dL
Uranium, Total	mg/l	0.02 ^h	3,320 ⁱ	<dL

^a For comparison purposes only.^b National Primary Drinking Water Regulations (40 CFR 141).^c DOE DCG for water (DOE Order 5400.5). DCG values are based on a committed effective dose of 100 mrem per year; however, because the drinking water maximum containment level is based on 4 mrem per year, the number listed is 4 percent of the DCG.^d Found in well 299-E28-25.^e Found in well 299-E28-23.^f Found in well 299-W19-24.^g Found in well 299-E17-9.^h Proposed National Primary Drinking Water Regulations, Radionuclides (56 FR 33050).ⁱ Found in well 299-W19-29.

Note: dL=detection limit.

Source: HF PNL 1994c.

training and laboratory facilities. Currently, DOE asserts a federally reserved water withdrawal right with respect to its existing Hanford operations and withdraws approximately 195 million l/yr (51.6 million gal/yr).

3.2.5 GEOLOGY AND SOILS

Geology. Hanford is located in a portion of the Pasco Basin, a topographic and structural depression in the southwest corner of the Columbia Basin physiographic subprovince. The Columbia Basin is a subprovince of the Columbia Intermontane physiographic province and is characterized by generally low-relief hills with incised river drainages. The Columbia Plateau is that portion of the Columbia Intermontane physiographic province that is underlain by the Columbia River Basalt Group and includes the Columbia Basin (HF PNL 1994a:4.20). The site is bounded on the west, southwest, and north by anticlinal ridges that trend eastward from the Cascade Mountains; on the east by the Columbia River with its steep, west-facing white bluffs; and on the southeast by the confluence of the Yakima and Columbia Rivers.

The stratigraphy of Hanford consists of Miocene-age and younger rocks which overlay older Cenozoic sedimentary and volcanoclastic basement rock. The major geologic units underlying Hanford are, in ascending order: subbasalt (basement) rocks, the Columbia River Basalt Group, the Ellenburg Formation, the Ringold Formation, the Plio-Pleistocene unit, early "Palouse" soil, and the Hanford Formation.

The Pasco Basin is filled with greater than 3 km (1.8 mi) of basalt of the Columbia River Basalt Group that overlies probable metasedimentary and metavolcanic rocks intruded by Mesozoic granitic rocks (HF DOE 1995g:4-7). The Columbia River Basalt Group consists of an accumulation of Eocene- to Pliocene-age basalt flows emitted concurrently with basin subsidence. Within and overlying the basalt sequence are tuffs and tuffaceous sediments of the Ellenburg Formation. This unit is overlain by the Mio-Pliocene Ringold Formation, a sequence of fluvial-lacustrine gravels and sands and floodplain silts and clays. These sediments were deposited by the ancestral Columbia River and its tributaries that flowed across the Pasco Basin after volcanic activity ceased. The upper part of the Ringold Formation is represented by an approximately 12-m (40-ft) bed in the western part of Hanford. The Plio-Pleistocene unit is a locally derived unit consisting of a sidestream alluvium and/or pedogenic calcrete and occurs at the unconformity between the Ringold Formation and the Hanford Formation (HF PNL 1994a:4.27). Overlying this unit in the Cold Creek syncline area is an aeolian silt and fine grained sand (early "Palouse" soil).

The tertiary sediments and basalts were locally eroded and truncated by a sequence of gigantic floods that took place within the past 100,000 years. These floods formed a channeled scabland that crosses the central and northeastern part of Hanford. This flooding deposited as much as 162 m (532 ft) of sands, gravels (Pasco Gravel), and clays (Touchet Beds) of the Hanford Formation. These units are, in turn, overlain by Holocene aeolian, alluvial, and landslide deposits interbedded with three to four thin, regional ash falls. Tectonic activity has continued through the Holocene, as evidenced by progressive warping of the Ringold Formation, decreasing upward through the section, and tilting of the Touchet Beds.

Hanford lies on the Hanford alluvial plain. Basalt outcrops are exposed on anticlinal ridges at Gable Mountain, Gable Butte, and the Saddle Mountains in the northern part of the reservation and on Rattlesnake Hills and Yakima Ridge, overlapping the western and southwestern edges of the reservation. Other than gravel, no economically viable geologic resources have been identified at Hanford.

The Modified Mercalli Intensity (MMI) scale, which evaluates earthquake intensity, and the Richter scale, which measures an earthquake's magnitude and energy, are both used to assess potential earthquake risk. Table 3.2.5-1 illustrates the approximate correlation between the MMI scale, the Richter scale, and maximum ground acceleration.

According to the 1994 Uniform Building Code, Hanford is in seismic zone 2B (ICBO 1994a). However, for this PEIS, Uniform Building Code Seismic Zones 2A and 2B were consolidated into Seismic Zone 2 (Figure 3.2.5-1). Seismic Zones 2A and 2B differ only in that Seismic Zone 2B represents the potential for slightly more damage than 2A corresponding to an earthquake intensity VII on the MMI scale.

Table 3.2.5-1. The Modified Mercalli Intensity Scale of 1931, With Approximate Correlations to Richter Scale and Maximum Ground Acceleration^a

Modified Mercalli Intensity ^b	Observed Effects of Earthquake	Approximate Richter Magnitude ^c	Maximum Ground Acceleration ^d
I	Usually not felt	<2	negligible
II	Felt by persons at rest, on upper floors or favorably placed	2-3	<0.003 G
III	Felt indoors; hanging objects swing; vibration like passing of light truck occurs; might not be recognized as earthquake	3	0.003 to 0.007 G
IV	Felt noticeably by persons indoors, especially in upper floors; vibration occurs like passing of heavy truck; jolting sensation; standing automobiles rock; windows, dishes, and doors rattle; wooden walls and frames may creak	4	0.007 to 0.015 G
V	Felt by nearly everyone; sleepers awaken; liquids disturbed and may spill; some dishes break; small unstable objects are displaced or upset; doors swing; shutters and pictures move; pendulum clocks stop or start		0.015 to 0.03 G
VI	Felt by all; many are frightened; persons walk unsteadily; windows and dishes break; objects fall off shelves and pictures fall off walls; furniture moves or overturns; weak masonry cracks; small bells ring; trees and bushes shake	5	0.03 to 0.09 G
VII	Difficult to stand; noticed by car drivers; furniture breaks; damage moderate in well built ordinary structures; poor quality masonry cracks and breaks; chimneys break at roof line; loose bricks, stones, and tiles fall; waves appear on ponds and water is turbid with mud; small earthslides; large bells ring	6	0.07 to 0.22 G
VIII	Automobile steering affected; some walls fall; twisting and falling of chimneys, stacks, and towers; frame houses shift if on unsecured foundations; damage slight in specially designed structures, considerable in ordinary substantial buildings; changes in flow of wells or springs; cracks appear in wet ground and steep slopes		0.15 to 0.3 G
IX	General panic; masonry heavily damaged or destroyed; foundations damaged; serious damage to frame structures, dams and reservoirs; underground pipes break; conspicuous ground cracks	7	0.3 to 0.7 G
X	Most masonry and frame structures destroyed; some well built wooden structures and bridges destroyed; serious damage to dams and dikes; large landslides; rails bent	8	0.45 to 1.5 G
XI	Rails bent greatly; underground pipelines completely out of service		0.5 to 3 G
XII	Damage nearly total; large rock masses displaced; objects thrown into air; lines of sight distorted	9	0.5 to 7 G

^a This table illustrates the approximate correlation between the MMI scale, the Richter scale, and maximum ground acceleration.

^b Intensity is a unitless expression of observed effects.

^c Magnitude is an exponential function of seismic wave amplitude, related to the energy released.

^d Acceleration is expressed in relation to the earth's gravitational acceleration (G).

Source: ICSSC 1985a; PPI 1994a.

Seismicity of the Columbia Plateau, as determined by the rate of earthquakes per area and the historical magnitude of these events, is relatively low when compared with other regions of the Pacific Northwest, the Puget Sound area, and western Montana/eastern Idaho (areas where several large earthquakes, Richter magnitude greater than 7, have occurred). Between 1870 and 1980, only five earthquakes occurred in the Columbia Plateau region that had MMI of VI or greater, and all these events occurred prior to 1937. The largest known earthquake in the Columbia Plateau (magnitude 5.75 and maximum MMI of VII) occurred in 1936 around Milton-Freewater, Oregon, approximately 100 km (62 mi) southeast of Hanford. In the central portion

of the Columbia, the largest earthquakes near Hanford were two earthquakes that occurred in 1918 and 1973. Each was approximate magnitude 4.5 and MMI V, and located north of Hanford. Most of the earthquakes in the central Columbia Plateau occur north or northeast of the Columbia River as "earthquake swarms," which are clusters of low intensity earthquakes (MMI less than V) occurring over a short period of time (HF PNL 1994a:4.36).

Most known faults at Hanford are associated with anticlinal fold axes and include thrust, reverse, and normal faults. Faulting has occurred concurrently with folding. The age of latest displacement for the major features is less than 10.5 million years, but some steep dipping faults in the Rattlesnake Hills uplift may be as young as 7,000 years. Some faults in Central Gable Mountain (north-central Hanford) are capable faults as defined in 10 CFR 100, Appendix A.

Landslides are present in the region and have been generally attributed to earthquake activity. Recent findings, however, suggest these features are actually related to glacial flooding and periods of soil saturation with water. Only the slopes of the enclosing anticlinal ridges, including Gable Mountain and White Bluffs, are steep enough for landslide concern. White Bluffs east of the Columbia River poses the greatest concern because of the clay-rich nature of some beds above the river level, the discharge of large quantities of irrigation water into the ground atop the cliffs, the surface incline toward the Columbia River, and the eastward channel migration of the Columbia and its undercutting of the adjacent bluffs. Landslides could fill the Columbia River channel and divert water onto the reservation.

Several major volcanoes are located in the Cascade Range west of Hanford, including Mount Adams, located 164 km (102 mi) from Hanford, and Mount St. Helens, located approximately 218 km (134 mi) west-southwest from Hanford. As a result of the 1980 Mount St. Helens eruption, approximately 0.1 cm (0.04 in) of volcanic ash fell in a 9-hour period at Hanford.

Soils. Hanford is primarily underlain by soils of the Ritzville-Willis, Warden-Shano, Walla-Walla-Endicott-Lickskillet, and Hezel-Quincy-Burbank associations. These soils tend to vary in texture from sand to silty and sandy loam derived from five types of parent material: recent alluvium, old alluvium (glacial outwash), windblown sand, lacustrine deposits, and loess. The mineralogy of these soils results from weathering of local basalts, igneous and metamorphic rocks exposed to the north and east. The hazard of soil erosion varies from slight to severe. Water erosion becomes more severe with increasing slope; wind erosion becomes more severe on water-eroded slopes. The soils at Hanford are considered acceptable for standard construction techniques.